

## VACUUM CLEANERS AND HOSES

This invention relates to vacuum cleaners of the kind including a suction unit and a flexible hose assembly.

Cylinder vacuum cleaners are used with a hose. Upright vacuum cleaners may also be used with a hose where it is necessary to clean less accessible locations. Hoses are also used in central vacuum cleaner installations, where a suction unit and ducting is built into a building. A long hose is useful in some situations but causes problems with storage and manipulation. The length of a hose is usually a compromise between a long length for ease of use and a short length to facilitate storage. One form of hose that can be long yet is easy to store is the extensible or stretch hose, which has a naturally short length but can be pulled to extend it to a longer length. The hose has a helical reinforcement with a natural contracted length but which can be extended resiliently. Although these hoses can be used satisfactorily, they have a disadvantage because the force needed to extend the hose and to maintain its extension makes it more difficult to manipulate the cleaning head. Furthermore, the force may pull over or move the vacuum cleaner or any furniture around which the hose is lead. One solution to this is the retractable hose, which has a naturally extended length and which can be retracted by suction. This is achieved by selecting the resilience of the helical reinforcement of the hose so that the suction created by the vacuum cleaner when the far end of the hose is obstructed is sufficient to pull the hose to a retracted length. The hose is then held in its retracted state so that it does not extend when the vacuum cleaner is turned off. This form of retractable hose is described in WO 03/024294. Although this form of hose has many advantages, there may be situations where it is desirable to have a hose that can be extended to even longer lengths but without an increased storage length, or where the construction of the hose does not allow for it to be retracted by suction, or where a non-retractable form of hose is preferred.

It is an object of the present invention to provide an alternative vacuum cleaner and hose.

According to one aspect of the present invention there is provided a vacuum cleaner of the above-specified kind, characterised in that the hose assembly includes at least two flexible sections one of which has a smaller external diameter than the other and is slidable within the other, and that the two sections are arranged to seal with one another at least when the two sections are extended relative to one another.

The flexible sections are preferably corrugated. The smaller diameter section may be stretchable from a natural short length to a longer length by applying an axial force. Alternatively, the smaller diameter section may be retractable from a natural extended length to a shorter length, such as by suction applied by the suction unit when the end of the hose assembly is occluded. The shorter length of the smaller diameter section may be substantially equal to the length of the larger diameter section. The two sections of the hose assembly may be provided with cooperating couplings that can be engaged with one another to retain the two sections in a compact configuration one within the other for storage. The larger diameter section of the hose assembly may be stretchable from a natural short length to a longer length by applying an axial force.

According to another aspect of the present invention there is provided a hose assembly for a vacuum cleaner, characterised in that the hose assembly includes inner and outer corrugated, flexible sections, that the inner section has a first end slidably retained within the outer section, that the hose assembly has a short configuration where the major part of the length of the inner section extends within the outer section and the first end of the inner section is located adjacent the first end of the outer section, and that the hose assembly has a longer configuration where the inner section is extended beyond a second end of the outer section and the first end of the inner section is located adjacent the second end of the outer section and in which a seal is provided between the two sections.

The inner section is preferably extensible from a shorter length substantially equal to the length of the outer section to a longer length greater than that of the outer section.

A vacuum cleaner including a hose assembly and its method of use, according to the present invention, will now be described, by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a simplified perspective view of the cleaner and hose assembly in an extended state; and

Figure 2 is a simplified enlarged cross-sectional view of a part of the hose assembly in an extended state.

With reference first to Figure 1 there is shown a vacuum cleaner including a suction unit 1, a hose assembly 2 and a cleaning wand 3 with a cleaning head 4 at one end.

The unit 1 is conventional, being a portable cylinder cleaner with a pump, dust collection bag, controls and filters of the usual kind (not shown). The unit 1 has a suction inlet 10 towards one end to which the hose assembly 2 is connected.

With reference now also to Figure 2, the hose assembly 2 has a first, outer section 20 with a coupling 21 at one end connected with the suction inlet 10. The main part of the first section 20 is provided by a corrugated, flexible tubular wall 22 of a plastics material, which is reinforced by a helical wire 23. The invention is also applicable to other forms of hose, such as those made entirely of plastics. The end of the first section 20 remote from the vacuum cleaner housing 1 is terminated by a sealing coupling 24. The first section 20 of the hose assembly 2 is typically about 1.8m long and is relatively inextensible axially. The first hose section 20 may alternatively be of a stretch construction, that is, one that has a natural short, retracted length but can be pulled by applying an axial force to a longer length against the axial resilience of the hose.

The hose assembly 2 also has a second, inner, smaller diameter section 25, which is flexible and corrugated, being provided by a sleeve 26 of a highly flexible plastics material supported on the outside of a helical reinforcement member in the form of a spring metal wire 27, as described in WO03024294. The helical reinforcement wire 27 has a natural extended

state but can be compressed axially against its resilience by an applied external force. The sleeve 26 is sufficiently flexible that the second section 25 itself naturally takes up the extended length of the reinforcement wire helix 27. The sleeve 26 has shallow hills extending outwardly between turns of the reinforcement wire 27, thereby allowing the sleeve to fold outwardly when the hose is retracted. The second section 25 is terminated at one end by a rigid circular end fitting 28 located within the first, larger diameter section 20 and freely slidable along it. The dimensions of the end fitting 28 and the coupling 24 on the first section are such as to prevent withdrawal of the end fitting. The end fitting 28 and the coupling 24 have engaging sealing surfaces 29 and 30 that extend laterally and abut and seal with one another when the end fitting is pulled against the coupling. The natural, extended length of the second section 25 is about 3.6m and it can be retracted to a length of about the same as that of the first section, that is, about 1.8m. This gives a total maximum length of about 5.4m. In general, if both sections of the hose are non-retractable or non-compressible the minimum overall length of the hose will be about 50% of its maximum length. Where one of the hose sections is retractable, as described above, the same maximum length can be achieved but the minimum length can be only about 25% of the maximum.

The opposite end of the second section 25 is terminated by a handle 32, such as of the kind described in GB2403403. The rear end of the handle 32 is formed with a coupling 33 adapted to mate with the coupling 24 at the end of the first section 20. The handle 32 has a trigger 34 that can be operated by the user to close a valve (not shown) within the handle and thereby prevent or restrict flow of air through the handle and hence along the hose assembly 2. The cleaning wand 3 is connected to the forward end of the handle 32.

Before use, the second section 25 is retracted and withdrawn within the first, outer section 20, as shown by the broken lines in Figure 2, and is held in this retracted state by engagement of the couplings 33 and 24, thereby providing a relatively compact configuration for storage. The hose assembly 2 can be used in this compact configuration for cleaning where a longer length is not needed. A stretch construction of the first section 20 facilitates use in this compact configuration. Normally, however, the user would release the two couplings 33 and 24 so that the resilience of the second section 25 extends it to its natural extended length. The user then pulls the second section 25 slightly to pull it out of the first

section 20 to its maximum extent, in a telescopic fashion. Until the end fitting 28 is pulled into sealing engagement with the coupling 24, air will be able to flow between the outside of the second section 25 and the coupling on the first section 20, so the suction effect at the cleaning head will be reduced. Once the end fitting 28 is engaged with the coupling 24, a seal is formed between the surfaces 29 and 30 preventing leakage of air into the hose assembly 2 except at the cleaning head 4. The total length of the extended hose assembly 2 is, therefore, equal to the combination of the length of the first section 20 and the extended length of the second section 25, that is, about 5.4m. It will be appreciated that, if the first, outer section 20 has a stretch construction, the overall effective length of the entire hose assembly can be further extended by applying a light pulling force to the remote end of the assembly.

When the user has finished cleaning and wishes to store the cleaner, he closes the trigger 34 on the handle 32 to restrict air flow along the hose assembly 2. This creates a suction pressure within the hose assembly 2 thereby retracting the second section 25 in length. The suction also has the effect of withdrawing the second section 25 back into the first section 20, telescopically, like a piston. Once the end fitting 28 is displaced from the coupling 24, some air will flow into the first section 20 at the coupling but it is still easy for the user fully to retract the second section 25 into the first with the combination of the suction and some manual guiding and pushing. When the second section 25 has been withdrawn fully into the first section 20 and has been retracted in length, the coupling 33 on the handle 32 is engaged with the coupling 24 on the first section. The vacuum cleaner can now be turned off allowing pressure within the hose assembly 2 to rise to atmosphere. The tendency of the second section 25 to extend is restrained by engagement of the couplings 33 and 24.

By providing for the second section 25 to slide within the first section 20 the overall effective length of the hose assembly 2 can be further extended over the arrangement described in WO03024294 without any increase in the stowed length of the hose assembly. Or, the same extended length can be achieved with a hose assembly having reduced stowed length.

The invention could also be used with conventional hoses that cannot be extended or retracted in length. In the simplest case, the user would simply pull the smaller diameter hose

out of the larger diameter hose to its full extent when cleaning and would push the two hoses telescopically together when the vacuum cleaner is to be stored. This enables the effective usable length of the hose to be up to twice that of the stowed length. In a modification of this arrangement employing conventional hose sections, the remote end of the hose assembly could have a valve similar to that described above that the user can close so that suction is created within the hose assembly. The suction helps produce a telescopic piston effect to withdraw the smaller diameter hose into the larger diameter hose.

It will be appreciated that the hose assembly could have various different configurations. For example, the hose assembly could include three or more hose sections of different diameters nested one within the other, so that the effective, usable, extended length of the hose is three or more times the stowed length. The larger diameter section could be secured at the remote end of the hose assembly and the smaller diameter section secured with the vacuum cleaner housing. The hose need not have a wire-reinforced construction but could, for example, be a low cost hose made entirely of plastics material.

The seal between the different sections of the hose need not be provided by abutting lateral surfaces but could instead be provided by one or more sliding seals, such as provided on the outer section facing inwardly to make a wiping seal with the outside of the inner section, or on the inner section facing outwardly to make a wiping seal with the inside of the outer section, or both of these arrangements.

The invention is not confined to portable cylinder cleaners but could be used with upright cleaners, central vacuum cleaner installations, fixed garage forecourt vacuum cleaners or the like.